

# Long-Term Geospatial Data Sets at USDA Experimental Sites for Climate Change Studies

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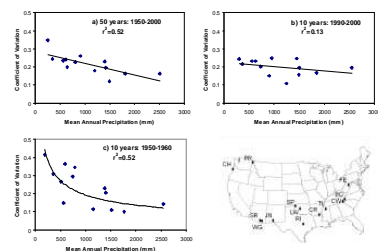
## Introduction

Repeat remote sensing field campaigns at USDA experimental sites have resulted in a valuable set of remote sensing data resources, geographic information system data sets, digitized maps, and tabular data that are tied to specific locations. An example is the Walnut Gulch Experimental Watershed (WGEW) in SE Arizona with over 50 years of data available through the ARIA, WIGDA and DAP web sites. In this review, we identified 81 US Department of Agriculture (USDA) experimental watersheds, forests and ranges with data records of more than 20 years measuring important ecosystem dynamics such as variations in vegetation, precipitation, climate, runoff, water quality and soil moisture. A simple analysis of some of these data underscored the need for continuous, interdisciplinary data records spanning more than 20 years across a wide range of ecosystems within and outside the conterminous USA to answer basic questions about climate change. Our results recommend the use of USDA long-term data sets for climate change research, and conversely, encourage local efforts to archive long-term geospatial data and distribute them online.

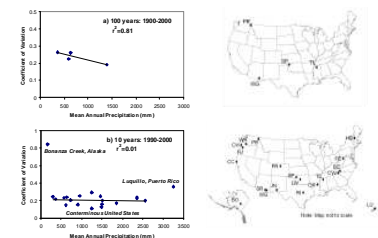
## Example: Value of Long-Term Data for Climate Change Studies

A simple analysis was conducted here based on long-term data available at USDA web sites to demonstrate why both depth and breadth are important for drawing proper conclusions, and at the same time, to show the ease of accessing such data for multi-site analysis. This analysis was not intended to be a complete study, but rather, an example of how USDA long-term data can be compiled and applied to critical ecophysiological questions at the national scale.

Many studies are based on the common assumption that the variability (coefficient of variation) of mean annual precipitation is negatively correlated with the magnitude of mean annual precipitation. This study shows that a variety of relations are obtained depending on the length and breadth of data.



Correlation between the variability (expressed as the coefficient of variation) of mean annual precipitation and the magnitude of mean annual precipitation for 13 USDA experimental sites (locations shown on inset map) with data in the EcoTrends project (1) for a 50-year data record from 1950 to 2000, b) a decade (1990 to 2000) characterized by several years of above-average rainfall, and c) a decade (1950 to 1960) characterized by severe drought conditions.



Same as above, except for a) 4 USDA sites over the 100-year period from 1900 to 2000 and b) 20 USDA sites over the 10-year period from 1990 to 2000, including two sites outside the conterminous US in Alaska and Puerto Rico.

## References

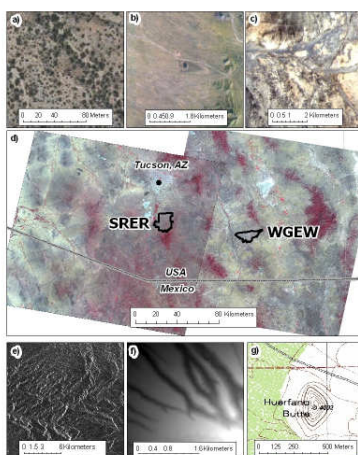
<http://www.tucson.ars.ag.gov/init/PublicationsSearch.html>

- Moran, M.S., Hutchinson, B., Marsh, S., McClaran, M., Olsson, A. 2009. Archiving and Disseminating Long-Term Geospatial Data. *IEEE Transactions on Geoscience and Remote Sensing* 47(1): 59-71.
- Moran, M.S., Peters, D.C., McClaran, M.P., Nichols, M.H., Adams, M.B. 2008. Long-term data collection and analysis: a review of the USDA experimental sites. *Ecol. Monogr.* 78: 377-393.
- Moran, M.S., Enmerich, W.E., Goodrich, D.C., Helman, P., Hottel Collins, C., Keeler, T.O., Heising, M.A., Nichols, M.H., Renard, K.G., Scott, R.L., Smith, J.R., Stone, J.J., Unkrich, C.L., Wong, J.K. 2008. *Long-term data collection on the USDA experimental sites*. Water Resources Research, Vol. 44, W05501, doi:10.1029/2007WR006083

## Long-Term Data at Walnut Gulch Experimental Watershed:

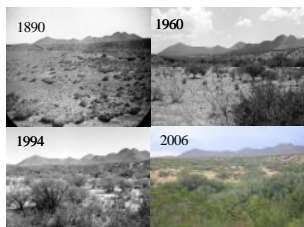
### ARIA, WIGDA and DAP

Arizona Regional Image Archive (ARIA) is an interdisciplinary resource system and online clearinghouse for digital image and map data for the Sonoran Desert region, including the U.S. Southwest and northern Mexico (<http://aria.arizona.edu>).



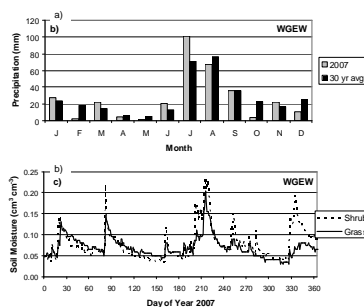
Location of WGEW with respect to Tucson, AZ, the US-Mexico border, and the footprints of two Landsat scenes (center panel (d)). In addition to the 85 scenes covering WGEW (Path 35/Row 38), ARIA contains imagery with high temporal resolution (MODIS, AVHRR, not pictured), a) high spatial resolution (DOQQ), b) high spectral resolution (AVIRIS), c) multiband thermal imagery (MTI), e) synthetic aperture radar (ERS-SAR) as well as f) digital elevation models (DEMs) and g) topographic maps (DRGs).

WGEW Image and Ground Data Archive (WIGDA) provides metadata that can be used to locate sets of image and ground data files at WGEW and surrounds over the past twenty years [http://www.tucson.ars.ag.gov/dap/remote\\_sensing.htm](http://www.tucson.ars.ag.gov/dap/remote_sensing.htm).



Example of historic repeat photography of WGEW: (top left) circa 1890, (top right) 1960, (bottom left) 1994, and (bottom right) 2006.

The Southwest Watershed Research Center Data Access Project (SWRC DAP) is an electronic data processing system that includes an online interface (<http://tucson.ars.ag.gov/dap>) to provide public access to data collected at WGEW.



Examples of data available through SWRC DAP: Average monthly precipitation data compiled for multiple ranges in WGEW, for the 30-year time period encompassing most ARIA image acquisitions and the most recent year 2007; and the volumetric soil moisture to a depth of approximately 15 cm measured daily in WGEW in 2007 at shrub- and grass-dominated sites, illustrating the spatial variability induced by localized storms across the watershed

## Long-term Data at All USDA Experimental Sites

We identified 81 U.S. Department of Agriculture (USDA) experimental watersheds, forests and ranges with data records of more than 20 years measuring important ecosystem dynamics, such as variations in vegetation, precipitation, climate, runoff, water quality and soil moisture. All 81 sites have long-term data available in machine readable format and most sites have data available for download from their website or from websites supported by other networks.

